

SEQUENCE LISTING

<110> Universiteit Utrecht Holding B.V.

<120> Piroplasmid vaccine

<130> 2003-010

<160> 20

<170> PatentIn version 3.2

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<211> 1818

<212> DNA

<213> Babesia bovis

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<221> CDS

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Val Gly Lys Ala Ile Ile Leu Glu Asn Gly Ala Asp Phe Leu Ser Ser				
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11/29

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Gly Thr Ser Gly Leu His Met Asp Trp Pro Val Val Cys Pro Val Tyr						
		435		440		445
Pro Ile Arg Asp Ser Ile Phe Gly Ser Tyr Asp Asp Gln Lys Asp Glu						
		450		455		460
Cys Val Pro Ile Glu Pro Ile Phe Glu Glu Glu Ala Glu Asp Tyr Glu						
		465		470		475
						480

Ala Cys Ala Lys Ile Ile Phe Glu Tyr Ser Pro Ser Asp Val Asp Ile
 485 490 495

Ser Thr Asn Asn Gln Lys Leu Ser Asp Val Asp Leu Tyr Lys Glu Ala
 500 505 510

Met Asn Asn Gly Lys Leu Ser Thr Ala Leu Ser Ile Met Phe Ala Pro
 515 520 525

Arg Tyr Ser Glu Asp Arg Pro Ile Tyr Thr Lys Gly Val Gly Ile Asn
 530 535 540

Trp Ala Thr Tyr Ser Val Glu Glu Lys Lys Cys Asn Ile Leu Asp Val
 545 550 555 560

Val Pro Ser Cys Leu Ile Ile Ser Asn Gly His Tyr Ala Leu Thr Ser
 565 570 575

Leu Ser Ser Pro Asn Glu Glu Asp Ala Ile Asn Tyr Pro Cys Asp Ile
 580 585 590

Val Gln Gly Lys Gly Phe Leu Lys Asn Pro Asn Gly Gly Lys Lys Asn
 595 600 605

Ala Gln Glu Pro Pro Lys Glu Pro Glu Pro Glu Glu Pro Lys Lys Glu
 610 615 620

Gly Ala Glu Asn Lys Pro Lys Glu Lys Gly Lys Ser Glu Lys Lys Asn
 625 630 635 640

Glu Lys Ser Met Pro Ser Gly Pro Phe Thr Pro Tyr Thr Ser Leu Lys
 645 650 655

Lys Glu Gly Phe Glu Cys Ser Lys Tyr Thr Val Glu Arg Val Asn Lys
 660 665 670

Ser Cys Gly Val Tyr Tyr Glu Cys Ser Glu Thr Pro Val Leu Phe Thr
 675 680 685

Lys Lys Asn Arg Ile Tyr Leu Tyr Ile Ile Leu Ala Val Ser Leu Val
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Val Leu Ala Val Leu Ala Tyr Phe Gly Tyr Arg Tyr Tyr Ser Lys Asn
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His Leu Lys Lys His Asn Ser Gln Ile Tyr Glu Asp Asp Asn Val Asn
725 730 735

Asn Tyr Tyr Asn Glu Asp Phe Asp Asp Glu Gln Asp Arg Asp Glu Tyr
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gcc ttt tta gct aca acg ggg ata cat gct ttt gcg gac aaa ggt att 96
Ala Phe Leu Ala Thr Thr Gly Ile His Ala Phe Ala Asp Lys Gly Ile
20 25 30
ggt tca cca aag ggg aaa caa tgc aag aag caa ctt gac ttt tcg att 144
Gly Ser Pro Lys Gly Lys Gln Cys Lys Lys Gln Leu Asp Phe Ser Ile
35 40 45
gtg gta gat gaa tct gct agt ata tcg gat gat caa tgg gag ggt cag 192
Val Val Asp Glu Ser Ala Ser Ile Ser Asp Asp Gln Trp Glu Gly Gln
50 55 60
atg att cca ttt ttg agg aat ttg att cat acc gtt gac ctt gac aac 240
Met Ile Pro Phe Leu Arg Asn Leu Ile His Thr Val Asp Leu Asp Asn
65 70 75 80
act gac ata cgt ctt tcg ctt acc act tac tca act cca act cgc cag 288
Thr Asp Ile Arg Leu Ser Leu Thr Thr Tyr Ser Thr Pro Thr Arg Gln
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ata ttt acg ttt ttg gat gct gct gca agc agt acc agg ctc gca ctc 336
Ile Phe Thr Phe Leu Asp Ala Ala Ser Ser Thr Arg Leu Ala Leu
100 105 110
acg aaa ctt gat tgg atg aac ggt acc aaa gct agg tat ggt atg acc 384
Thr Lys Leu Asp Trp Met Asn Gly Thr Lys Ala Arg Tyr Gly Met Thr
115 120 125

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Tyr Thr Gly Arg Ala Leu Asn Tyr Val Arg Lys Ala Ile Leu Pro Tyr	
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ggc cgc aag aat gta ccc aag gca ctg tta ctg atc act gat gga gta	480
Gly Arg Lys Asn Val Pro Lys Ala Leu Leu Ile Thr Asp Gly Val	
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Ser Ser Asp Gly Ser Tyr Thr Ala Gln Val Ala Ala Met Leu Arg Asp	
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Glu Gly Val Asn Val Met Val Ile Gly Val Gly Asp Val Asn Val Ala	
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Glu Cys Arg Gly Ile Val Gly Cys Asp Gly Ile Met Asp Cys Pro Met	
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ttc aag cag acc aac tgg aag gat atc atg ggc ctc ttt aac agt tta	672
Phe Lys Gln Thr Asn Trp Lys Asp Ile Met Gly Leu Phe Asn Ser Leu	
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Val Trp Ala Glu Trp Ser Ser Cys Asn Gly Glu Cys Gly Val Pro Gly	
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Lys Arg Thr Arg Ala Leu Leu Asp Leu Arg Met Ile Glu Lys Pro Val	
260 265 270	
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Asn Gly Ser Asn Gly Gln Pro Gly Lys Ser Cys Glu Asp Gln Lys Met	
275 280 285	
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Asn Phe Leu Pro Gln Ser Glu Thr Cys Thr Ile Glu Cys Asn His Glu	
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cct gtg cca agc tcg ccg gaa cct gta tca gat gat atg gat cac cca	960
Pro Val Pro Ser Ser Pro Glu Pro Val Ser Asp Asp Met Asp His Pro	
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Glu Pro Thr Pro Val Thr Pro Glu Gly Asp Met Asp Lys Ser His Ser	
325 330 335	
cat tcg agc att cca tcc acc cct gat atg cca tca agt cac agt gat	1056
His Ser Ser Ile Pro Ser Thr Pro Asp Met Pro Ser Ser His Ser Asp	
340 345 350	
atg tca tca agc cct act gat atg tca tca agc cct act gac atg tca	1104
Met Ser Ser Ser Pro Thr Asp Met Ser Ser Ser Pro Thr Asp Met Ser	
355 360 365	
tca agc cct act gac atg tca tca agt cac agt gac atg cca tca act	1152

Ser 370	Ser	Pro	Thr	Asp	Met	Ser	Ser	Ser	His	Ser	Asp	Met	Pro	Ser	Thr	
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cct	act	ggc	atg	tca	tca	agt	cac	agt	gat	atg	cca	tca	agt	cac	agt	1200
Pro	Thr	Gly	Met	Ser	Ser	Ser	His	Ser	Asp	Met	Pro	Ser	Ser	His	Ser	
385						390				395					400	
gat	atg	cca	tca	agc	cac	agt	gat	atg	tca	tca	agc	cct	act	gac	atg	1248
Asp	Met	Pro	Ser	Ser	His	Ser	Asp	Met	Ser	Ser	Ser	Pro	Thr	Asp	Met	
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tca	tca	agt	cac	gct	gat	act	cgt	gta	gga	aat	acc	gat	gaa	gaa	cat	1296
Ser	Ser	Ser	His	Ala	Asp	Thr	Arg	Val	Gly	Asn	Thr	Asp	Glu	Glu	His	
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Asn	His	Arg	Lys	Asp	Met	Asp	Val	Lys	Phe	Pro	Glu	Asn	Met	Asp	Asp	
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Ile	Pro	Val	Glu	Asp	Asn	Pro	Ile	Pro	Thr	Asp	Pro	Arg	His	Gly	Val	
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Glu	Pro	Ser	Pro	Ser	Asp	Val	Ile	Pro	Glu	Asp	Asp	Gln	Leu	Arg	Arg	
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Thr	Leu	Glu	Met	Gln	Arg	Glu	Glu	Asp	Leu	Lys	Lys	Glu	Leu	Met	Leu	
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caa	cat	gaa	ctg	aag	ctt	cag	gaa	gaa	aag	gaa	agg	gca	gct	att	tta	1536
Gln	His	Glu	Leu	Lys	Leu	Gln	Glu	Glu	Lys	Glu	Arg	Ala	Ala	Ile	Leu	
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Glu	Asn	Asn	Thr	Pro	Tyr	Gly	Ser	Ala	Thr	Ser	Val	Ser	Gln	Asp	Gly	
		515					520					525				
gaa	tct	cca	act	ggc	gta	ccc	caa	agt	agc	gag	acc	gat	gca	ata	cgt	1632
Glu	Ser	Pro	Thr	Gly	Val	Pro	Gln	Ser	Ser	Glu	Thr	Asp	Ala	Ile	Arg	
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cac	gag	gtg	tat	gac	gat	cac	ccc	gag	gaa	tct	gaa	aac	acc	ggg	att	1680
His	Glu	Val	Tyr	Asp	Asp	His	Pro	Glu	Glu	Ser	Glu	Asn	Thr	Gly	Ile	
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aat	gct	gat	gtg	acc	gaa	tct	gag	gac	tat	gag	ggc	gaa	aaa	caa	aag	1728
Asn	Ala	Asp	Val	Thr	Glu	Ser	Glu	Asp	Tyr	Glu	Gly	Glu	Lys	Gln	Lys	
				565					570					575		
gac	gaa	tca	aat	gaa	cgt	tcg	acc	agc	aat	act	act	aag	att	gcc	ggc	1776
Asp	Glu	Ser	Asn	Glu	Arg	Ser	Thr	Ser	Asn	Thr	Thr	Lys	Ile	Ala	Gly	
			580					585					590			
ggc	gct	cta	cta	ggc	ctt	ctt	ctc	ctt	ggc	gcc	ggc	ggc	gga	tac	gct	1824
Gly	Ala	Leu	Leu	Gly	Leu	Leu	Leu	Leu	Gly	Ala	Gly	Gly	Gly	Tyr	Ala	
		595					600					605				
atg	tac	aaa	aag	aac	aag	aca	cct	act	gtt	gag	aca	ggc	tca	ggc	gat	1872
Met	Tyr	Lys	Lys	Asn	Lys	Thr	Pro	Thr	Val	Glu	Thr	Gly	Ser	Gly	Asp	

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Tyr Thr Gly Ala Asp Glu Ser Ser Glu Pro Met Lys Glu Gly Asp Thr
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tac acc gtc act gag ttt gac aac aac att tgg ggc gag gca gcg taa      1968
Tyr Thr Val Thr Glu Phe Asp Asn Asn Ile Trp Gly Glu Ala Ala
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<213> Babesia bovis

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Gly Ser Pro Lys Gly Lys Gln Cys Lys Lys Gln Leu Asp Phe Ser Ile
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Val Val Asp Glu Ser Ala Ser Ile Ser Asp Asp Gln Trp Glu Gly Gln
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Met Ile Pro Phe Leu Arg Asn Leu Ile His Thr Val Asp Leu Asp Asn
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Thr Asp Ile Arg Leu Ser Leu Thr Thr Tyr Ser Thr Pro Thr Arg Gln
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Ile Phe Thr Phe Leu Asp Ala Ala Ala Ser Ser Thr Arg Leu Ala Leu
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Thr Lys Leu Asp Trp Met Asn Gly Thr Lys Ala Arg Tyr Gly Met Thr
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Tyr Thr Gly Arg Ala Leu Asn Tyr Val Arg Lys Ala Ile Leu Pro Tyr
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Gly Arg Lys Asn Val Pro Lys Ala Leu Leu Leu Ile Thr Asp Gly Val
145                150                155                160

Ser Ser Asp Gly Ser Tyr Thr Ala Gln Val Ala Ala Met Leu Arg Asp
        165                170                175

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Glu Gly Val Asn Val Met Val Ile Gly Val Gly Asp Val Asn Val Ala
 180 185 190

Glu Cys Arg Gly Ile Val Gly Cys Asp Gly Ile Met Asp Cys Pro Met
 195 200 205

Phe Lys Gln Thr Asn Trp Lys Asp Ile Met Gly Leu Phe Asn Ser Leu
 210 215 220

Met Lys Glu Val Cys Asp Ile Leu Pro Gln Asp Ala Val Cys Glu Pro
 225 230 235 240

Val Trp Ala Glu Trp Ser Ser Cys Asn Gly Glu Cys Gly Val Pro Gly
 245 250 255

Lys Arg Thr Arg Ala Leu Leu Asp Leu Arg Met Ile Glu Lys Pro Val
 260 265 270

Asn Gly Ser Asn Gly Gln Pro Gly Lys Ser Cys Glu Asp Gln Lys Met
 275 280 285

Asn Phe Leu Pro Gln Ser Glu Thr Cys Thr Ile Glu Cys Asn His Glu
 290 295 300

Pro Val Pro Ser Ser Pro Glu Pro Val Ser Asp Asp Met Asp His Pro
 305 310 315 320

Glu Pro Thr Pro Val Thr Pro Glu Gly Asp Met Asp Lys Ser His Ser
 325 330 335

His Ser Ser Ile Pro Ser Thr Pro Asp Met Pro Ser Ser His Ser Asp
 340 345 350

Met Ser Ser Ser Pro Thr Asp Met Ser Ser Ser Pro Thr Asp Met Ser
 355 360 365

Ser Ser Pro Thr Asp Met Ser Ser Ser His Ser Asp Met Pro Ser Thr
 370 375 380

Pro Thr Gly Met Ser Ser Ser His Ser Asp Met Pro Ser Ser His Ser
 385 390 395 400

Asp Met Pro Ser Ser His Ser Asp Met Ser Ser Ser Pro Thr Asp Met
 405 410 415

Ser Ser Ser His Ala Asp Thr Arg Val Gly Asn Thr Asp Glu Glu His
 420 425 430

Asn His Arg Lys Asp Met Asp Val Lys Phe Pro Glu Asn Met Asp Asp
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Ile Pro Val Glu Asp Asn Pro Ile Pro Thr Asp Pro Arg His Gly Val
 450 455 460

Glu Pro Ser Pro Ser Asp Val Ile Pro Glu Asp Asp Gln Leu Arg Arg
 465 470 475 480

Thr Leu Glu Met Gln Arg Glu Glu Asp Leu Lys Lys Glu Leu Met Leu
 485 490 495

Gln His Glu Leu Lys Leu Gln Glu Glu Lys Glu Arg Ala Ala Ile Leu
 500 505 510

Glu Asn Asn Thr Pro Tyr Gly Ser Ala Thr Ser Val Ser Gln Asp Gly
 515 520 525

Glu Ser Pro Thr Gly Val Pro Gln Ser Ser Glu Thr Asp Ala Ile Arg
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His Glu Val Tyr Asp Asp His Pro Glu Glu Ser Glu Asn Thr Gly Ile
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Asn Ala Asp Val Thr Glu Ser Glu Asp Tyr Glu Gly Glu Lys Gln Lys
 565 570 575

Asp Glu Ser Asn Glu Arg Ser Thr Ser Asn Thr Thr Lys Ile Ala Gly
 580 585 590

Gly Ala Leu Leu Gly Leu Leu Leu Leu Gly Ala Gly Gly Gly Tyr Ala
 595 600 605

Met Tyr Lys Lys Asn Lys Thr Pro Thr Val Glu Thr Gly Ser Gly Asp
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 <213> Theileria annulata

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 His Arg Glu Leu Asp Leu Thr Ile Leu Val Asp Glu Ser Ser Ser Ile
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 tat att gaa gag tgg aac aaa ctc att cca ttt ctt aaa tca ctg gtg 144
 Tyr Ile Glu Glu Trp Asn Lys Leu Ile Pro Phe Leu Lys Ser Leu Val
 35 40 45
 aga tca ata aat ata agt cca aat tat gtg cac ttg tca atg gtc acc 192
 Arg Ser Ile Asn Ile Ser Pro Asn Tyr Val His Leu Ser Met Val Thr
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 Phe Ser Thr Ser Ile Arg Trp Leu Ile Ser Phe Leu Asp Pro Ala Ser
 65 70 75 80
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 Lys Asp Glu Gln Leu Ala Leu Ala Val Leu Asp Lys Leu Lys Asn Ser
 85 90 95
 aag cct gtg ttt ggg tac aca ttc act gga cag gca ctt aac ttt att 336
 Lys Pro Val Phe Gly Tyr Thr Phe Thr Gly Gln Ala Leu Asn Phe Ile
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 tct gag gct gtt tat atg ttt ggt gct agg cgt aac tct cca aag ggc 384
 Ser Glu Ala Val Tyr Met Phe Gly Ala Arg Arg Asn Ser Pro Lys Gly
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 Ile Ile Ile Ile Thr Asp Gly Ser Ser Thr Gln Thr Asn Val Thr Ser
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 Gln Ala Ser Ala Leu Leu Arg Asp Ala Gly Val Thr Ile Leu Val Val
 145 150 155 160
 gga gtt ggg aag gct aaa gaa agc gag tgt aga ggt ata gtt ggt tgt 528
 Gly Val Gly Lys Leu Lys Glu Ser Glu Cys Arg Gly Ile Val Gly Cys
 165 170 175
 tct acc aaa gga gag tgc ccc ctt ttc ttt atg acc aac tgg gat gaa 576
 Ser Thr Lys Gly Glu Cys Pro Leu Phe Phe Met Thr Asn Trp Asp Glu
 180 185 190
 att atc agg aag gtt ggg gag ttg atg gct gag gtt tgt gag acc att 624
 Ile Ile Arg Lys Val Gly Glu Leu Met Ala Glu Val Cys Glu Thr Ile

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cct aag gac gcc gta tgt	aag ccg atc tgg tct	gat tgg tct aag tgt	672
Pro Lys Asp Ala Val Cys	Lys Pro Ile Trp Ser	Asp Trp Ser Lys Cys	
210	215	220	
gac gcc aag tgc ggc att	ggg acg agg tac caa aag	ttg atg gga gtt	720
Asp Ala Lys Cys Gly Ile	Gly Thr Arg Tyr Gln Lys	Leu Met Gly Val	
225	230	235	240
act aca att tct gag cca	act gtc gga acg aac	ggc aag tcc ggg agg	768
Thr Thr Ile Ser	Glu Pro Thr Val Gly	Thr Asn Gly Lys Ser	
245	250	255	
aca tgt gag atg att tat	gag aac gtc gag gtt	cca aag gag gag tgc	816
Thr Cys Glu Met Ile Tyr	Glu Asn Val Glu Val	Pro Lys Glu Glu Cys	
260	265	270	
tcc gtt gag tct aag att	gct gga gga gtg gct	cta gca ctg tta atg	864
Ser Val Glu Ser Lys Ile	Ala Gly Gly Val Ala	Leu Ala Leu Leu Met	
275	280	285	
ctt gca ggc gga ggt ggt	tac aca tac tac aaa	aag tac ggt tta tct	912
Leu Ala Gly Gly Gly Gly	Tyr Thr Tyr Tyr Lys	Lys Tyr Gly Leu Ser	
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Arg Val Ser Glu Thr Thr	Asn Leu Asp Glu Asp	Phe Ala Asp Ser Ser	
305	310	315	320
ggg aac cgt ggt gta agg	gag agt gtg ggt gaa	gct tac aca gta act	1008
Gly Asn Arg Gly Val Arg	Glu Ser Val Gly Glu	Ala Tyr Thr Val Thr	
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<213> Theileria annulata

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Arg Ser Ile Asn Ile Ser Pro Asn Tyr Val His Leu Ser Met Val Thr
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Phe Ser Thr Ser Ile Arg Trp Leu Ile Ser Phe Leu Asp Pro Ala Ser
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Lys Asp Glu Gln Leu Ala Leu Ala Val Leu Asp Lys Leu Lys Asn Ser
85 90 95

Lys Pro Val Phe Gly Tyr Thr Phe Thr Gly Gln Ala Leu Asn Phe Ile
100 105 110

Ser Glu Ala Val Tyr Met Phe Gly Ala Arg Arg Asn Ser Pro Lys Gly
115 120 125

Ile Ile Ile Ile Thr Asp Gly Ser Ser Thr Gln Thr Asn Val Thr Ser
130 135 140

Gln Ala Ser Ala Leu Leu Arg Asp Ala Gly Val Thr Ile Leu Val Val
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Gly Val Gly Lys Ala Lys Glu Ser Glu Cys Arg Gly Ile Val Gly Cys
165 170 175

Ser Thr Lys Gly Glu Cys Pro Leu Phe Phe Met Thr Asn Trp Asp Glu
180 185 190

Ile Ile Arg Lys Val Gly Glu Leu Met Ala Glu Val Cys Glu Thr Ile
195 200 205

Pro Lys Asp Ala Val Cys Lys Pro Ile Trp Ser Asp Trp Ser Lys Cys
210 215 220

Asp Ala Lys Cys Gly Ile Gly Thr Arg Tyr Gln Lys Leu Met Gly Val
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Thr Thr Ile Ser Glu Pro Thr Val Gly Thr Asn Gly Lys Ser Gly Arg
245 250 255

Thr Cys Glu Met Ile Tyr Glu Asn Val Glu Val Pro Lys Glu Glu Cys
260 265 270

Ser Val Glu Ser Lys Ile Ala Gly Gly Val Ala Leu Ala Leu Leu Met
275 280 285

Leu Ala Gly Gly Gly Gly Tyr Thr Tyr Tyr Lys Lys Tyr Gly Leu Ser
290 295 300

22/29

Arg Val Ser Glu Thr Thr Asn Leu Asp Glu Asp Phe Ala Asp Ser Ser
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Gly Asn Arg Gly Val Arg Glu Ser Val Gly Glu Ala Tyr Thr Val Thr
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Asp Leu Asp Asp Gly Leu Trp Ser Gln Ser Asn Gln
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<212> DNA
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<220>
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Lys Thr Phe Gly Asp Glu Ser Val Ser Leu Leu Glu His Glu Ser Thr
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agt ttg tct cgt ggt cct aga cca acc gaa gat caa atc agt cag tta 734
Ser Leu Ser Arg Gly Pro Arg Pro Thr Glu Asp Gln Ile Ser Gln Leu
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cca aaa aat gtt ttc ttt cta ttg gat aac agc att gat atg tct att 782
Pro Lys Asn Val Phe Phe Leu Leu Asp Asn Ser Ile Asp Met Ser Ile
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Leu Lys Lys Tyr Glu Gly Ile Asn Val Ser Leu Ile Arg Tyr Asn Ser	
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Glu Glu Pro Leu Gly Ser Thr Lys Ala Leu Thr Asn Gly Glu Leu Lys	
110 115 120 125	
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Lys Leu Ser Asp Asn Ile Pro Thr Lys Met Pro Phe Asp Ile Gly Val	
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Val Pro Thr Gly Ile Gly Ala Ala Leu Lys Gln Ile Lys Thr Leu Tyr	
145 150 155	
cct gat cac gaa aag ttc ctt gtt ggg aac acc att act gag ttg gat	1070
Pro Asp His Glu Lys Phe Leu Val Gly Asn Thr Ile Thr Glu Leu Asp	
160 165 170	
tat tct aaa gca ttg ggt aag gat att gtt gta atc gtg ttt act act	1118
Tyr Ser Lys Ala Leu Gly Lys Asp Ile Val Val Ile Val Phe Thr Thr	
175 180 185	
ggc cac gtc att gat cca tat tta gca tat gat gag gca ttt gat gcc	1166
Gly His Val Ile Asp Pro Tyr Leu Ala Tyr Asp Glu Ala Phe Asp Ala	
190 195 200 205	
cgc cgt aat ggt gta aga ttt tac gtt att aat agg gga gga aag gca	1214
Arg Arg Asn Gly Val Arg Phe Tyr Val Ile Asn Arg Gly Gly Lys Ala	
210 215 220	
aaa aac tat tgg act cag cta ttg gga tgc cac tac aat act tgt ttg	1262
Lys Asn Tyr Trp Thr Gln Leu Leu Gly Cys His Tyr Asn Thr Cys Leu	
225 230 235	
agt tat att cgg gcc aaa ata aca agg cct tca cta tat ctc gat gtt	1310
Ser Tyr Ile Arg Ala Lys Ile Thr Arg Pro Ser Leu Tyr Leu Asp Val	
240 245 250	
ttg gtg aac agg att gtg tct aaa cgc gcg aaa gat gcc gtt tgt ttg	1358
Leu Val Asn Arg Ile Val Ser Lys Arg Ala Lys Asp Ala Val Cys Leu	
255 260 265	
gaa gtg tgg acg gat tat aaa cct aac act gaa aaa tgc gat gtg agg	1406
Glu Val Trp Thr Asp Tyr Lys Pro Asn Thr Glu Lys Ser Asp Val Arg	
270 275 280 285	
att atg act tct acg ttg aaa tta tac aaa acc ctt ctt act gga agc	1454
Ile Met Thr Ser Thr Leu Lys Leu Tyr Lys Thr Leu Leu Thr Gly Ser	
290 295 300	
ttt gcg gag ara aac atc aaa ggt ctc aca tgt gat gag cag cta aag	1502
Phe Ala Glu Xaa Asn Ile Lys Gly Leu Thr Cys Asp Glu Gln Leu Lys	
305 310 315	
gat atg cag aaa aga caa ata ttt tgc tac tca aat aag tgt gct ccc	1550

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 <213> Babesia bovis

<220>
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 <222> (305)..(305)
 <223> The 'Xaa' at location 305 stands for Arg, or Lys.

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Met Val Lys Phe His Thr Leu Ser Val Ala Ala Ile Leu Ala Ile Ala
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Ser Ser Asn Thr Ile Phe Ala Thr Phe Arg Ser Asn Gly Lys Thr Phe
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Gly Asp Glu Ser Val Ser Leu Leu Glu His Glu Ser Thr Ser Leu Ser
 35 40 45

Arg Gly Pro Arg Pro Thr Glu Asp Gln Ile Ser Gln Leu Pro Lys Asn
 50 55 60

Val Phe Phe Leu Leu Asp Asn Ser Ile Asp Met Ser Ile Glu Thr Gly
 65 70 75 80

Glu Glu Asn Arg His Phe Leu Ser Glu Phe Phe Lys Leu Leu Lys Lys
 85 90 95

Tyr Glu Gly Ile Asn Val Ser Leu Ile Arg Tyr Asn Ser Glu Glu Pro
 100 105 110

Leu Gly Ser Thr Lys Ala Leu Thr Asn Gly Glu Leu Lys Lys Leu Ser
 115 120 125

Asp Asn Ile Pro Thr Lys Met Pro Phe Asp Ile Gly Val Val Pro Thr
 130 135 140

Gly Ile Gly Ala Ala Leu Lys Gln Ile Lys Thr Leu Tyr Pro Asp His
 145 150 155 160

Glu Lys Phe Leu Val Gly Asn Thr Ile Thr Glu Leu Asp Tyr Ser Lys
 165 170 175

Ala Leu Gly Lys Asp Ile Val Val Ile Val Phe Thr Thr Gly His Val
 180 185 190

Ile Asp Pro Tyr Leu Ala Tyr Asp Glu Ala Phe Asp Ala Arg Arg Asn
 195 200 205

Gly Val Arg Phe Tyr Val Ile Asn Arg Gly Gly Lys Ala Lys Asn Tyr
 210 215 220

Trp Thr Gln Leu Leu Gly Cys His Tyr Asn Thr Cys Leu Ser Tyr Ile
 225 230 235 240

Arg Ala Lys Ile Thr Arg Pro Ser Leu Tyr Leu Asp Val Leu Val Asn
 245 250 255

Arg Ile Val Ser Lys Arg Ala Lys Asp Ala Val Cys Leu Glu Val Trp
 260 265 270

Thr Asp Tyr Lys Pro Asn Thr Glu Lys Ser Asp Val Arg Ile Met Thr
 275 280 285

Ser Thr Leu Lys Leu Tyr Lys Thr Leu Leu Thr Gly Ser Phe Ala Glu
 290 295 300

Xaa Asn Ile Lys Gly Leu Thr Cys Asp Glu Gln Leu Lys Asp Met Gln
 305 310 315 320

Lys Arg Gln Ile Phe Cys Tyr Ser Asn Lys Cys Ala Pro Thr Ile Tyr
 325 330 335

Ser Arg Ser Tyr Val Asp Leu Ala Ile Gln Arg Leu Asn Ala Lys Asp
 340 345 350

Phe Lys Glu Val Leu Asp Glu Ser Ser Tyr Arg Ser Arg Ser Leu Gln
 355 360 365

Ser Val Glu Lys His Asn Glu Gln Gln Thr Gly Ser Gln Glu Thr Leu
 370 375 380

Ser Gly Ser Ala Arg Val Glu Thr Ser Leu Glu Ser Ser Val Pro Ser
 385 390 395 400

Ser Tyr Val Ala Glu Leu Gly Glu Ser Asp Thr Glu Thr Tyr Lys Gln
 405 410 415

Leu Glu Tyr Ile Asp Lys Asn Gly Val Thr Val Phe Asn Asp Glu Pro
 420 425 430

Thr Val Val Val Asp Thr Pro Glu Tyr Val Gln Lys Val His Glu Arg

435 440 445

Glu Met Gln Phe Asp Glu Glu Ser Thr His Leu Pro Asn Ser Gly Asn
450 455 460

His His Pro Pro His His Arg Lys Gly Ala Asn Gly Ser Gly Lys Lys
465 470 475 480

Thr Thr Ile Val Val Gly Ile Ile Cys Leu Val Val Ile Cys Ala Val
485 490 495

Ile Ala Gly Ala Tyr Leu Ser Leu Ser Gln Gln Glu Ser Val Glu Leu
500 505 510

Thr Ser Glu Glu Gly Asp Phe Leu Asn Asp Thr Thr Gly Gly Gln Pro
515 520 525

Glu Val Leu Glu Thr Gln Gln Val Val Asp Ala Glu Asn Lys Thr Trp
530 535 540

Leu
545

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<220>
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22

<210> 12
<211> 24
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<220>
<223> primer 2

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24

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<223> Primer 8

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